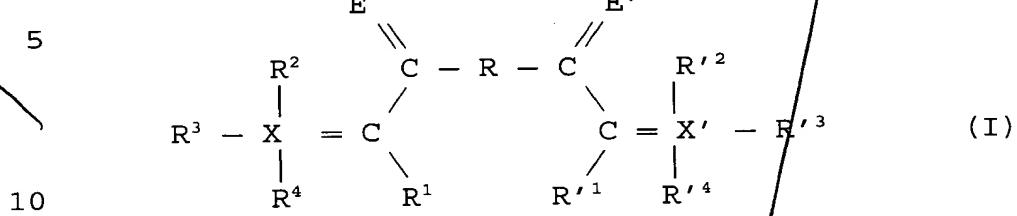


CLEAN VERSION OF CLAIMS

CLAIMS

46 - A catalytic system comprising:

(A) at least one ligand represented by formula (I):



where:

- E and E' each represent independently an oxygen or a sulfur atom;
- X and X' each represent independently a phosphorus, arsenic or antimony atom;
- the radicals R¹ and R'¹, which are identical or different, are selected from:
 - . hydrogen;
 - . linear, branched or cyclic alkyl radicals;
 - . aryl radicals;
 - . arylalkyl radicals;
 - . alkylaryl radicals;
 - . halogens;
 - . the hydroxyl radical;
 - . alkoxide radicals;
 - . -C=OR', where R' represents a hydrocarbon radical which has from 1 to 15 carbon atoms;
 - . -SO₃Y, where Y is selected from Li, Na, NH₄⁺, NR''₄⁺, where R'' represents a hydrocarbon radical which has from 1 to 15 carbon atoms;
- the R², R'², R³, R'³, R⁴ and R'⁴ radicals, which are identical or different, are selected from linear,

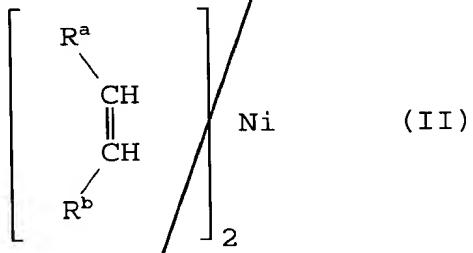
branched or cyclic alkyl radicals, and arylalkyl radicals;

- R is a divalent radical; and

(B) at least one nickel compound selected from:

5 (B1) nickel complexes with a zero oxidation state, which are represented by the general formula (II):

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15



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where R^a and R^b each represent independently a hydrogen atom, or a linear, branched or cyclic alkyl radical or aryl, arylalkyl or alkylaryl radical, which have up to 8 carbon atoms, it being also possible for R^a and R^b to form together a divalent aliphatic group of 2 to 10 carbon atoms and have up to three olefinic double bonds as the only carbon-carbon unsaturated groups;

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(B2) π -allylnickels, which are represented by the formula (III):

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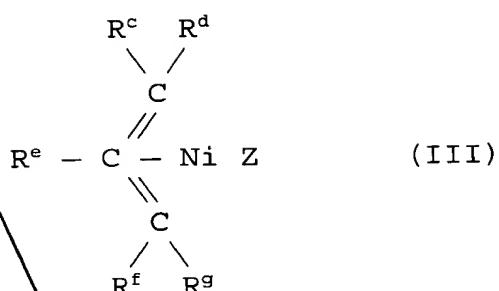
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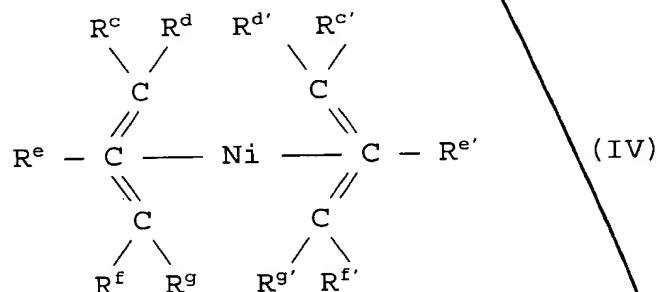
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in which:

- the R^c , R^d , R^e , R^f and R^g radicals, which are identical or different, are selected from hydrogen, linear, branched or cyclic alkyl radicals and aryl, arylalkyl or alkylaryl radicals, having up to 8 carbon atoms;
- the dotted lines represent the electron delocalization on the three contiguous carbon atoms;
- an R^c or R^d radical may also form, with an R^e or R^f or R^g radical, a divalent alkene group having from 2 to 10 carbon atoms and able to have up to three olefinic double bonds; and
- Z represents a halogen, an alkoxy group or an alkanoyloxy group;

(B3) compounds of the bis(allyl)nickel type which are represented by the (IV) :



in which:

5

- the radicals R^c to R^g , and $R^{c'}$ to $R^{g'}$, which are identical or different, are selected from hydrogen, linear, branched or cyclic alkyl radicals and aryl, arylalkyl or alkylaryl radicals having up to 8 carbon atoms;
- the dotted lines represent the electron delocalization on the three contiguous carbon atoms;
- 10 - a radical R^c or R^d also able to form, with a radical R^e or R^f or R^g , a divalent alkene group having from 2 to 10 carbon atoms and able to have up to three olefinic double bonds;
- a radical $R^{c'}$ or $R^{d'}$ also able to form, with a radical $R^{e'}$ or $R^{f'}$ or $R^{g'}$, a divalent alkene group having from 2 to 10 carbon atoms and able to have up to three olefinic double bonds.

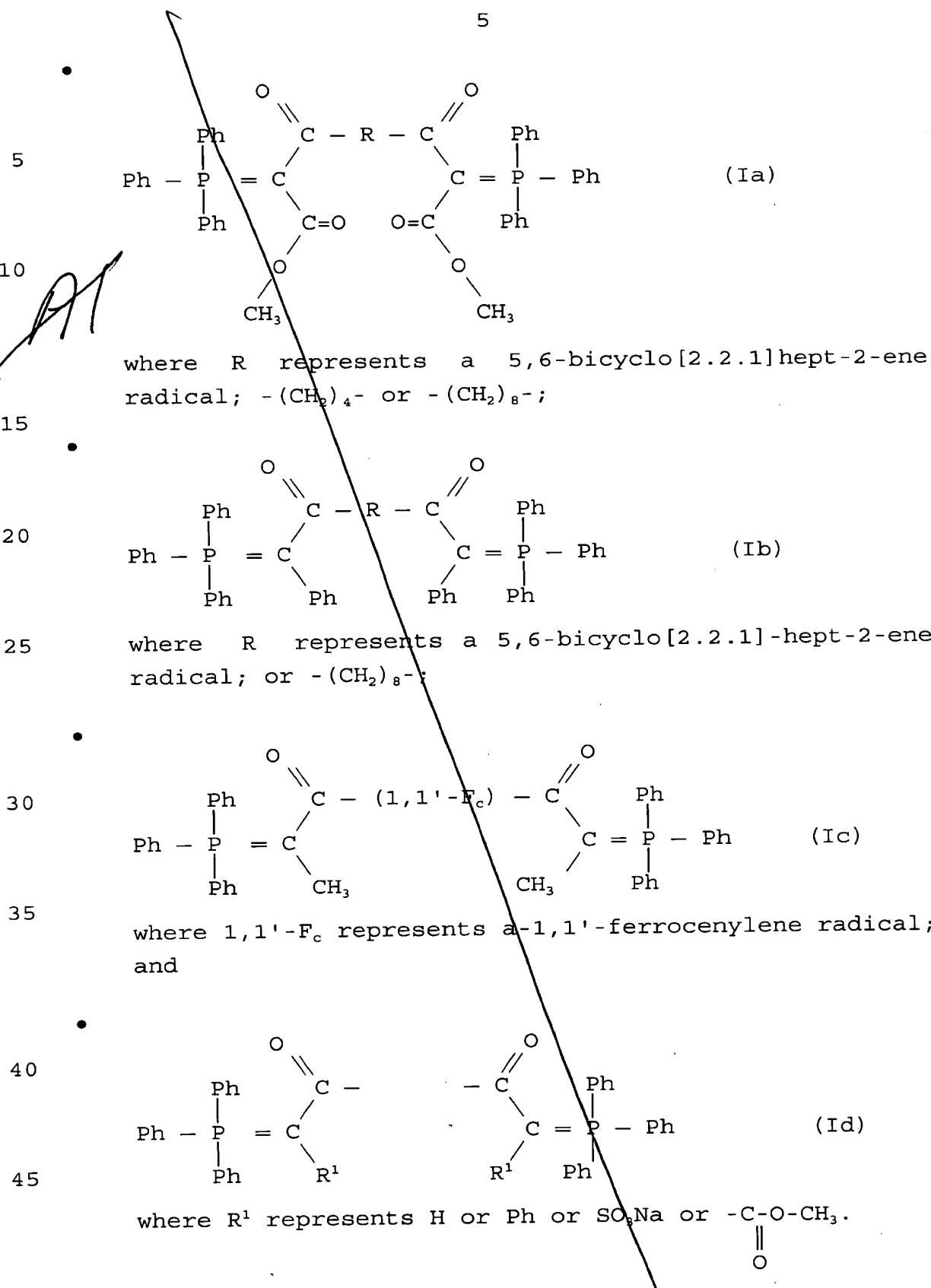
20 47 - The catalytic system as claimed in claim 46, wherein, in formula (I), E and E' are separated by intermediate atoms linked together by covalent or coordinate bonds.

48 - The catalytic system as claimed in claim 46, wherein, in formula (I), the minimum number of atoms between E and E' is from 3 to 40.

25 49 - The catalytic system as claimed in claim 46, wherein, in formula (I), R is selected from:

- . divalent hydrocarbon radicals comprising from 2 to 38 carbon atoms; and
- . the 1,1'-ferrocenylene radical which is substituted or 30 unsubstituted.

50 - The catalytic system as claimed in claim 46, wherein the ligand of formula (I) comprises one of the following structures:



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51 - The catalytic system as claimed in claim 46, wherein the nickel compound (B₁) is selected from:

- . bis(1,5-cyclooctadiene)nickel(0);
- . bis(cyclooctatetraene)nickel(0); and
- 5 . bis(1,3,7-octatriene)nickel(0).

52 - The catalytic system as claimed in claim 46, wherein, in a nickel compound (B₂) or (B₃), a π -allyl group has from 3 to 12 carbon atoms which do not have other aliphatic unsaturated groups, except where it contains a 10 closed cycle.

53 - The catalytic system as claimed in claim 46, wherein the nickel compound (B₂) is selected from:

- . π -allylnickel chloride;
- . π -allylnickel bromide;
- 15 . π -crotylnickel chloride;
- . π -methylallylnickel chloride;
- . π -ethylallylnickel chloride;
- . π -cyclopentallylnickel bromide;
- . π -cyclooctenylnickel chloride;
- 20 . π -cyclooctadienylnickel chloride;
- . π -cinnamylnickel bromide;
- . π -phenylallylnickel chloride;
- . π -cyclohexenylnickel bromide;
- . π -cyclododecenylnickel chloride;
- 25 . π -cyclododecatrienylnickel chloride;
- . π -allylnickel acetate;
- . π -methylallylnickel propionate;
- . π -cyclooctenylnickel octoate;
- . π -cyclooctenylnickel methoxylate; and
- 30 . π -allylnickel ethoxylate.

54 - The catalytic system as claimed in claim 46, wherein the nickel compound (B₃) is selected from:

- . bis(π -allyl)nickel;
- . bis(π -methallyl)nickel;
- 35 . bis(π -cinnamyl)nickel;
- . bis(π -octadienyl)nickel;
- . bis(π -cyclohexenyl)nickel;
- . π -allyl- π -methallylnickel; and

1 bis(*n*-cyclooctatrienyl)nickel.

25 55 - The catalytic system as claimed in claim 46, wherein the components (A) and (B) are present in amounts such that the nickel-to-ligand(s) molar ratio is between 1 and 100.

5 56 - The catalytic system as claimed in claim 55, wherein the components (A) and (B) are present in amounts such that the nickel-to-ligand(s) molar ratio is between 2 and 50.

10 57 - A process for the polymerization of at least one olefin in the presence of a catalytic system as defined in claim 46.

58 - The process as claimed in claim 57, wherein:

15 - in a first step, each of the constituents (A) and (B), which are in solution in an inert solvent, are introduced separately or simultaneously into a reactor, together with the reaction mixture; and

20 - in a second step, the olefin or olefins are introduced, the (co)polymerization taking place at a temperature between 0 and 300°C and at a total absolute pressure of from 1 to 200 bar.

59 - The process as claimed in claim 58, wherein the constituents (A) and (B) are introduced in a nickel-to-ligand(s) molar ratio of between 1 and 100.

25 60 - The process as claimed in claim 59, wherein the constituents (A) and (B) are introduced in a nickel-to-ligand(s) molar ratio of between 2 and 50.

30 61 - The process as claimed in claim 58, wherein the inert solvent of constituents (A) and (B) is selected from saturated aliphatic hydrocarbons, saturated alicyclic hydrocarbons, aromatic hydrocarbons and mixtures thereof.

62 - The process as claimed in claim 58, wherein the reaction mixture consists of an organic medium.

35 63 - The process as claimed in claim 58, wherein the reaction mixture comprises a continuous liquid aqueous phase, which comprises more than 30% water by weight.

64 - The process as claimed in claim 63, wherein the aqueous phase is the only liquid phase.

65 - The process as claimed in claim 63, wherein the mixture comprises an organic liquid phase.

66 - The process as claimed in claim 62, wherein the medium or the organic phase is selected from:

5 - saturated aliphatic hydrocarbons, saturated alicyclic hydrocarbons, aromatic hydrocarbons and mixtures thereof; and

6 - to the extent that the polymerization conditions keep them in liquid form, α -olefins, unconjugated dienes and mixtures thereof.

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67 - The process as claimed in claim 63, wherein the polymerization medium comprises a dispersing agent.

68 - The process as claimed in claim 67, wherein
the dispersing agent is present at up to 10% by weight for
15 the weight of water.

69 - The process as claimed in claim 68, wherein the dispersing agent is present at 0.01 to 5% by weight for the weight of water.

70 - The process as claimed in claim 63, wherein
20 the polymerization medium comprises an emulsifying agent.

71 - The process as claimed in claim 70, wherein the emulsifying agent is present at up to 10% by weight, for the weight of water.

Subcl 1 72 - The process as claimed in claim 71, wherein
25 the ~~emulsifying~~ agent is present at 0.01 to 5% by weight for
the weight of water.

73 - The process as claimed in claim 70, wherein the emulsifying agent is present in an amount greater than the critical micelle concentration.

30 74 - The process as claimed in claim 73, wherein
the amount of emulsifying agent is enough so that the
polymerization takes place mainly in the micelles.

75 - The process as claimed in claim 70, wherein
the polymerization medium comprises a liquid organic phase
35 and a cosurfactant.

76 - The process as claimed in claim 75, wherein the polymerization mixture comprises a liquid organic phase and a cosurfactant.

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77 - The process as claimed in claim 76, wherein the cosurfactant has a solubility in water of less than 1×10^{-3} mol per liter at 20°C.

5 78 - The process as claimed in claim 76, wherein the cosurfactant is present at up to 10% by weight for the weight of water.

79 - The process as claimed in claim 76, wherein the emulsifying agent to cosurfactant mass ratio goes from 0.5 to 2.

10 80 - The process as claimed in claim 58, wherein the concentration of the constituent (A) in the inert solvent is between 0.1 micromol and 100 millimol per liter of solution.

15 81 - The process as claimed in claim 58, wherein the concentration of the constituent (B) in the inert solvent is between 0.1 micromol and 200 millimol per liter of solution.

82 - The process as claimed in claim 58, wherein it is carried out in an inert atmosphere.

20 ~~Sub C2~~ 83 - The process as claimed in claim 58, wherein in a preliminary step, the constituents (A) and (B) in solution are brought into contact with each other in their inert solvent, for a duration of 30 seconds to 10 minutes, before their introduction into the reaction mixture, this 25 precontacting step being carried out in an inert atmosphere, at a temperature of between 0 and 100°C.

84 - The process as claimed in claim 83, wherein this precontacting step is carried out at a temperature between 10 and 70°C.

30 85 - The process as claimed in claim 58, wherein the constituents (A) and (B), which are in solution in their inert solvent, are introduced separately into the reaction mixture, the latter being held at a temperature of from 0 to 100°C.

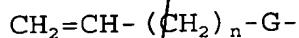
35 86 - The process as claimed in claim 85, wherein the reaction mixture is held at a temperature from 10 to 70°C.

87 - The process as claimed in claim 58, wherein the (co)polymerization is carried out at a temperature of between 25 and 200°C.

5 88 - The process as claimed in claim 58, wherein the (co)polymerization is carried out at a total absolute pressure of from 1 to 100 bar.

10 89 - The process as claimed in claim 58, wherein the olefin or olefins intended to be polymerized are introduced in gas or liquid form, with enough stirring of the polymerization medium.

90 - The process according to claim 58, wherein the olefins are selected from ethylene, α -olefins, cyclic olefins and compounds of formula:



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in which:

- n is an integer between 2 and 20; and
- G is a radical chosen from:
 - OH; CHOHCH_2OH ; OT; $-\text{CF}_3$; $-\text{COOT}$; $-\text{COOH}$;
 - $-\text{Si}(\text{OH})_3$; $-\text{Si}(\text{OT})_3$;

20 T is a hydrocarbon radical having from 1 to 20 carbon atoms.

91 - The process as claimed in claim 58, wherein at least one olefin is ethylene.

25 92 - The process as claimed in claim 70, wherein the polymerization is carried out in the presence of an emulsifying agent, leading therefore to a latex, if necessary after a filtration step.

30 93 - The process as claimed in claim 92, wherein the latex is a high-density polyethylene or a medium-density polyethylene or a low-density polyethylene.

94 - The process as claimed in claim 71, wherein the emulsifying agent is present at up to 0.01 to 5% by weight, for the weight of water.